Proceeding Paper

Modelling Digital Circular Economy framework in the Agricultural Sector. An Application in Southern Italy [†]

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Abstract: The transition towards circular economy (CE) in agriculture requires a large amount of data in order to map the consumption of natural resources and negative externalities. This paper aims to identify a digital framework for collecting and sharing data fundamental for stakeholders with the purpose of implementing the best CE model. The methodology used is based on the guidelines of the stakeholder engagement and through a survey, and the authors have mapped the lack of data and built a set by replicable sustainability indicators. The results obtained can be used for the definition of regional policy strategies and interventions for CE model implementation.

Keywords: agriculture; circular economy; survey; data; indicators; digital framework

1. Introduction

Digital transformation plays a fundamental role in all economic sectors, especially in agriculture [1]. For this reason, currently, the paradigm of data collection needs to be improved, as suggested by [2], in order to present a systematic model to enable stakeholders to transition towards CE.

2. Literature Review

The scientific interest in the fundamental digital transformation to implement the CE in agriculture is fairly recent, as the Web of Science (WoS) platform highlighted only two a few results. According to [2], the correct coordination between computer devices and agriculture can contribute to improvement in the management of farms and their practices. In 2019, other scholars [3] stated that a long-term agricultural data collection model ensured comprehensive monitoring of sustainable agriculture and the design of development plans. Given the shortage of this significant practice [4], we proposed this study in order to increase the scientific production and suggest a new framework for implementing CE in agriculture.

3. Materials and Methods

3.1. Methods

The methodology used is defined by the guidelines on stakeholder engagement (AA1000 SES) issued by [5] and based on three key items: 1. involving stakeholders to understand their expectations on governance, policies, strategies, and practices; 2. reporting of data and questions in accordance with transparency and clarity; 3. developing an innovative framework to address the sustainability issue.

3.2. Materials

The stakeholder engagement methodology is based on questionnaire administration to understand the needs identified by stakeholders and farmers during planning and managing project activities concerning the sustainability and circular economy issue. Data gathered through the questionnaire were processed and transformed through a statistical tool into a shareable framework.

3.2.1. Questionnaire

We developed a questionnaire jointly for with public administration for mapping the needs of stakeholders in terms of information and knowledge to implement CE. Table 1 displays the 21 questions, which are categorized into four areas of investigation.

Table 1. Structure of questionnaire.

| Area	Questions	*n.*
General	Professional area General difficulties for farmers to implement CE Information for implementing SA	1–3
Circular Economy	CE practices in Apulia Farmers' interest in CE CE model in Apulian agriculture Obstacles in CE implementation Range of problems Fundamental keys for CE implementation Effective processes Sustainability indicators	4–11
Water Resource	Wastewater reuse in Apulian agriculture Practices of wastewater reuse Spreading olive oil mill wastewater (OOMW) Information of Regional Water Protection Plan Instruments and tools for improving CE of water resource	12–16
Planning	Relevant topic for planning and financing calls Digital data and information Collaboration for designing digital framework Advice Sharing results	17–21

3.2.2. Sample

Jointly with a regional body, we made a list of stakeholders involved in the survey. The sample was composed of 32 stakeholders from different areas that operate in private associations, public authorities, research centers, and regional agencies connected with the Apulian agricultural sector. The questionnaire was shared through a digital platform.

4. Results

Concerning question 2, half of the answers showed an absence of direct channels of information for CE in the Apulian agricultural sector and 40% complained of the lack of technical training. Two thirds of the answers for question 3 stated that Apulian farmers require information about sustainable use of natural resources. Additionally, according to 75% of the sample investigated, in the Apulian agriculture sector, some models of CE have been activated anyway. Thirty-three percent of these stakeholders were contacted about wastewater reuse in the past. All stakeholders agreed that regional farmers face difficulties in implementing an appropriate and useful model of CE, mostly (67%) due to a lack of information and specific training. According to our stakeholder sample, sustainable water use will be an important key to implement CE in Apulia, and wastewater reuse and food waste reuse followed. Notwithstanding the successful framework to implement CE will

be the adoption of participatory processes between stakeholders and farmers. In terms of sustainable indicators, 67% of the sample were aware of them, whereas, according to 16% of the stakeholders, in the Apulian agriculture sector, wastewater reuse based on rainwater storage is widespread. Thirty-three percent of the sample has already had to deal with farmers who practised an agronomic use of vegetation waters. Unfortunately, no farmers know the Regional Water Protection Plan. Fifty-eight percent of the sample focused on the need for coordination between the different implementing bodies. Additionally, for planning and financing activities, the management of digital information and the use of a connected network will be fundamental. Currently, according to 92% of the sample, Apulian farmers have difficulties in retrieving collected and digital information in the short term. Nevertheless, 67% of the sample is available to collaborate for planning a participatory model for collected information useful for implementing CE in Apulia. It has to be underlined that all stakeholders agreed to share the results of this survey.

Finally, in the last step of this study, we developed some indicators for making a framework useful for all stakeholders involved in the agri-food chain (from farmers to public and private bodies) for implementing a successful CE model in agriculture. Figure 1 displays a replicable framework organized into the eight most important topics that are interconnected and fundamental to meet the needs highlighted by our sample.
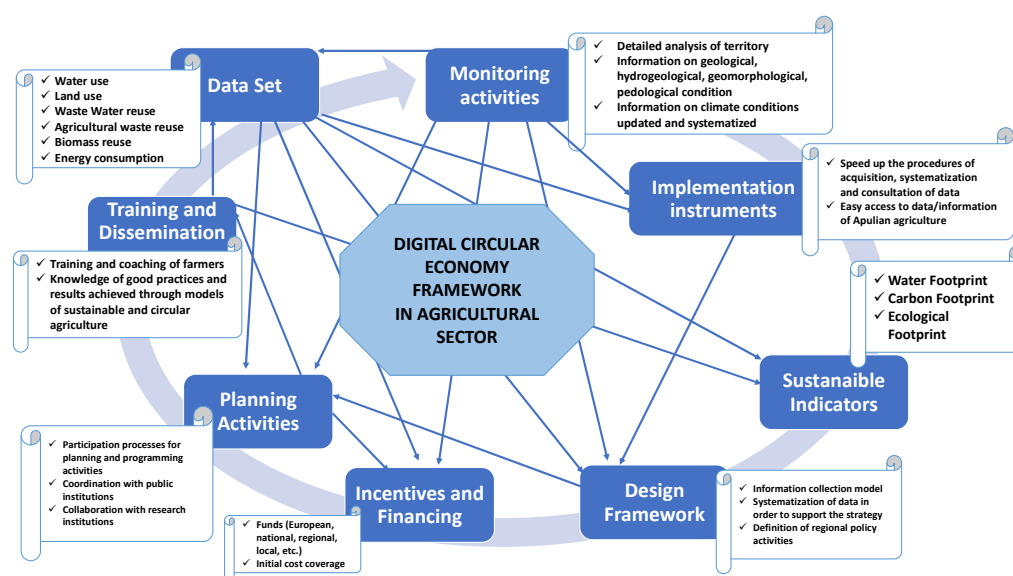
Figure 1. Framework for implementing a CE model in agriculture. Source: Authors' own work.

5. Discussion

This paper deals with some useful insights from the scientific literature in order to create a digital framework for data collection and sharing in agriculture. Furthermore, this analysis feeds responsible innovation processes for a correct transition from the linear economy to circular economy [1]. The investigation, undertaken through the use of digital tools, encompassed the consumption of natural resources, such as water resources, and the knowledge of some sustainability indicators and limitations to implementing CE in agriculture. This information is significant for planning activities, creating financing policies, and enabling the implementation of tools for Apulian agriculture. Therefore, based on the first questionnaire administered to the sample (public and private bodies and associations of agriculture), the need to conduct training and dissemination activities based on bottom-up and top-down approaches emerged. The key element for the transition to the CE is represented by the collaboration between farmers and stakeholders to design agricultural management based on a digital model of data, information, and knowledge.

6. Conclusions

We proposed this framework based on a dynamic and interdependent relationship between several fundamental steps to design a transition towards a CE approach. This digital framework improves stakeholders' decision making [6] and leads to greater cooperation in the agricultural supply chain in Southern Italy and in the Mediterranean area. It is a knowledge model that allows for overcoming the obstacles that the stakeholders of the agricultural supply chain face in the data procurement phase [7]. Furthermore, since this is the building of a replicable framework, it allows the spread of soft culture and digital learning, creating a virtuous network to be implemented in the Mediterranean area. We have thus strengthened the capacity of public administrations by combining scientific research and public/private interests for the implementation of the circular economy approach. Therefore, this new framework can spin public administration to design plans, strategies, and programs and enable stakeholders to know the most suitable sustainability indicators to implement the best CE model. In conclusion, digital transformation in agriculture supports a framework of digital-enabled circular strategies for farms and manufacturing.

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